PATENT ABSTRACTS OF JAPAN

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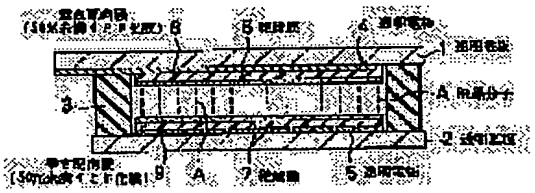
(54) LIQUID CRYSTAL ELEMENT

(57)Abstract:

PURPOSE: To uniformalize optical characteristics, to unify the inclination directions of liquid crystal molecules when an electric field is impressed thereto and to enable the execution of stable display operations by laminating monomolecular films of the reaction compd. of polyamic acid and long-chain alkyl amine and imidizing the films at a specific imidization rate, thereby forming perpendicularly oriented films.

CONSTITUTION: Transparent electrodes 4, 5 are respectively formed on the surfaces facing each other of a pair of transparent substrates 1, 2 consisting of glass, etc. The electrode forming surfaces of the two substrates 1, 2 are coated with transparent insulating films 6, 7 consisting of silicon oxide, etc., and the perpendicularly oriented films 8, 9 for orienting the liquid crystal molecules A nearly perpendicularly to the planes of the substrates 1, 2 are formed on these insulating films 6, 7. Both of the perpendicularly oriented films are formed by laminating the monomolecular films of the reaction compd. of the polyamic acid and the long-chain alkyl amine in plural layers and imidizing these films at the imidization rate α% in a $0<\alpha<50$ range.



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CLAIMS

[Claim(s)]
[Claim 1] To the field which counters mutually [the transparence substrate of the couple which counters on both sides of a liquid crystal layer], a transparent electrode, It comes to form the vertical orientation film for carrying out orientation of the liquid crystal molecule with a predetermined inclination to the normal of a substrate side. And said vertical orientation film The liquid crystal device which carries out the laminating of the monomolecular film of the reaction compound of polyamic acid and long-chain alkylamine, and is characterized by consisting of film with which rate of imide-izing alpha% was imide-ized in 0< alpha<50.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the liquid crystal device to which vertical orientation of the liquid crystal molecule was carried out.
[0002]
[Description of the Prior Art] There are things, such as dynamic scattering (DS) mode, vertical orientation mold mode of the electric-field control mold birefringence (ECB) modes, and phase transition mode, in the liquid crystal device to which vertical orientation of the liquid crystal molecule was carried out.
[0003] These liquid crystal devices are the things in which a transparent electrode and the vertical orientation film for carrying out orientation of the liquid crystal molecule vertically to a substrate side were formed to the field which counters mutually [the transparence substrate of the couple which counters on both sides of a liquid crystal layer], and said vertical orientation film is formed by making a substrate side apply and dry conventionally the surfactant solution which has a long-chain alkyl group.
[0004]
[Problem(s) to be Solved by the Invention] However, the conventional liquid crystal device which applies a surfactant solution as mentioned above and forms the vertical orientation film In order that vertical orientation of the liquid crystal molecule cannot be carried out uniformly, therefore a uniform optical property may not be obtained, since dispersion is in the stacking tendency of the vertical orientation film, and a liquid crystal molecule may carry out orientation in the nearly completely vertical condition to an orientation film surface, It had the problem that the display action which the liquid crystal molecule when impressing electric field to a liquid crystal layer fell, and a direction was not fixed, therefore was stabilized was not obtained.
[0005] The object of this invention is to offer the liquid crystal device to which the display action which was made to carry out orientation of the liquid crystal molecule to an abbreviation perpendicular uniformly, made the optical property homogeneity, the liquid crystal molecule when moreover impressing electric field fell, fixed the direction, and was stabilized can be made to perform.
[0006]
[Means for Solving the Problem] The liquid crystal device of this invention to the field which counters mutually [the transparence substrate of the couple which counters on both sides of a liquid crystal layer] A transparent electrode, It comes to form the vertical orientation film for carrying out orientation of the liquid crystal molecule with a predetermined inclination to the normal of a substrate side. And said vertical orientation film The laminating of the monomolecular film of the reaction compound of polyamic acid and long-chain alkylamine is carried out, and rate of imide-izing alpha% is characterized by consisting of film imide-ized in 0< alpha<50.
[0007]
[Function] The orientation film with which rate of imide-izing alpha% made the film which carried out the laminating of the monomolecular film of the reaction compound of the above-mentioned polyamic acid and long-chain alkylamine imide-ize in 0< alpha<50 has the stacking tendency to which orientation of

the liquid crystal molecule is carried out almost vertically with few pre tilt angles to the normal of an orientation film surface, and the stacking tendency is uniform over the orientation film whole region. For this reason, since according to the liquid crystal device of this invention orientation of the liquid crystal molecule is carried out uniformly, a uniform optical property can be obtained and a liquid crystal molecule carries out orientation uniformly with the above-mentioned pre tilt angle, the liquid crystal molecule when impressing electric field can fall, and the display action which fixed the direction and was stabilized can be made to perform.

[0008]

[Example] Hereafter, one example of this invention is explained with reference to drawing 1 and drawing 2.

[0009] Drawing 1 is the sectional view of a liquid crystal device. This liquid crystal device joins the transparence substrates 1 and 2 of a couple which consist of glass etc. through the frame-like sealant 3, it is what enclosed liquid crystal with both this substrate 1 and the field surrounded by the sealant 3 between two, and transparent electrodes 4 and 5 are formed in the field where both the above-mentioned substrates 1 and 2 counter mutually, respectively. Moreover, the electrode forming face of both these substrates 1 and 2 is covered by the transparent insulator layers 6 and 7 which consist of oxidation silicon (Si O2) etc., and the vertical orientation film 8 and 9 for carrying out orientation of the liquid crystal molecule A almost vertically to the 1 or 2nd page of a substrate is formed on these insulator layers 6 and 7.

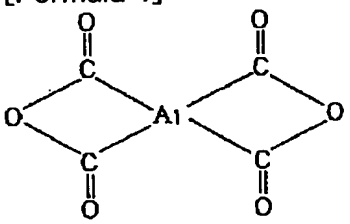
[0010] Rate of imide-izing alpha% makes the film with which the above-mentioned vertical orientation film 8 and 9 all carried out the laminating of the monomolecular film of the reaction compound of polyamic acid and long-chain alkylamine to two or more layers imide-ize in 0< alpha<50.

[0011] These vertical orientation film 8 and 9 is formed by the following approaches. In addition, although formation of the vertical orientation film 8 prepared in one substrate 1 is explained, the vertical orientation film 9 prepared in the substrate 2 of another side is formed similarly here.

[0012] The above-mentioned polyamic acid is expressed with the structure expression of the following [-izing 3], and this polyamic acid compounds the tetracarboxylic dianhydride expressed with the structure expression of [-izing 1], and the diamine expressed with the structure expression of [-izing 2], and is obtained.

[0013]

[Formula 1]



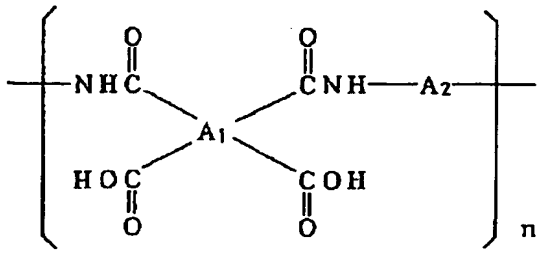
[0014]

[Formula 2]

$H_2N-A_2-NH_2$

[0015]

[Formula 3]

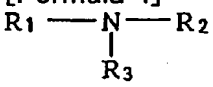


nは1以上の整数

[0016] Moreover, the above-mentioned long-chain alkylamine is for giving hydrophobicity to polyamic acid with a hydrophilic property, and this long-chain alkylamine is expressed with the structure expression of the next [-izing 4].

[0017]

[Formula 4]



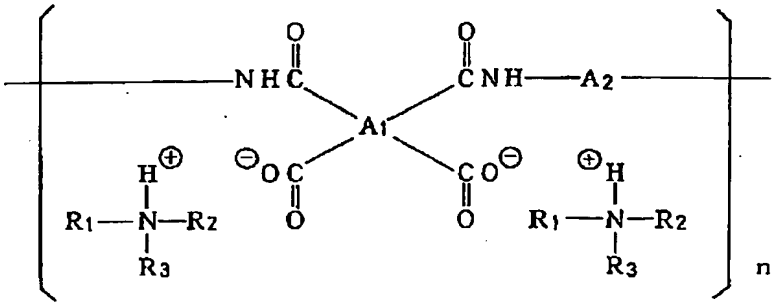
R1 , R2 は低級アルキル基または水素原子

R3 は長鎖のアルキル基

[0018] The solution which melted the above-mentioned polyamic acid to the solvent, and the solution which melted the above-mentioned long-chain alkylamine to the same solvent are mixed at a rate of 1:1, the ionic bond reaction of the above-mentioned polyamic acid and the long-chain alkylamine is carried out, and the solution of the polyamic acid derivative compound (polyamic acid salt) expressed with the structure expression of the following [-izing 5] is created. In addition, as a solvent of the above-mentioned polyamic acid and long-chain alkylamine, the mixed solvent which mixed NMP (N-methyl-2-pyrrolidinone) and benzene at a rate of 1:1 is used. Moreover, the concentration of a long-chain alkylamine solution is the same as the concentration of a polyamic acid solution, or let it be concentration deeper than it.

[0019]

[Formula 5]



[0020] and the substrate 1 top which the level orientation film 8 formed the transparent electrode 4, and formed the insulator layer 6 on it — LB — carry out the laminating of the monomolecular film of the above-mentioned polyamic acid derivative compound to a necessary layer, and it is made to put on it by law, and the cascade screen of this monomolecular film is imide-ized by heat treatment, and is formed. drawing 2 — a substrate 1 top — the monomolecular film of a polyamic acid derivative compound — LB — how to make it covering by law is shown. Covering of this monomolecular film is performed as follows. First, hydrophilic processing is performed to the monomolecular-film covering side (the 6th page of insulator layer) of the above-mentioned substrate 1, and this substrate 1 is made immersed at right angles to underwater [in a cistern 10].

[0021] Next, after making the water surface in a cistern 10 into a potentiometric surface, the solution of

the above-mentioned polyamic acid derivative compound is dropped on the water surface between the migration barrier 11 of the shape of a bar prepared in water surface height, and a substrate 1, and the monomolecular film a is developed on the water surface.

[0022] Next, moving the migration barrier 11 in the direction of a substrate with constant speed (2 mm/min), and pushing a monomolecular film a in the direction of a substrate moving the migration barrier 11 in the direction of a substrate, clustering the single molecule on the water surface, and adjusting the surface pressure of a monomolecular film a to 1 constant pressure (25 dyn/cm), it is made to align with this, a substrate 1 is pulled up, and the monomolecular film a on the water surface is made to put on a substrate 1.

[0023] Since a part with a hydrophilic property adheres to the substrate 1 which has performed hydrophilic processing and the single molecule on the water surface can be pulled up at this time, a molecule puts a monomolecular film a on a substrate 1 in the condition of having stood in a line in the about 1 direction. The following repeats the covering process of the above-mentioned monomolecular film a, and carries out the laminating of the above-mentioned monomolecular film a to a necessary layer on a substrate 1.

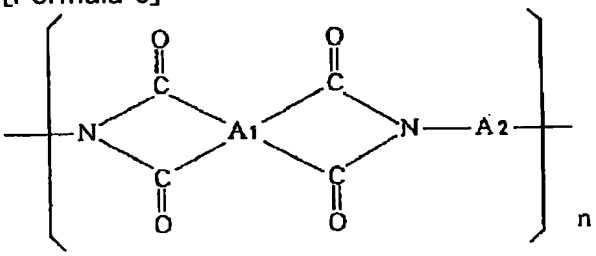
[0024] Thus, the cascade screen of this monomolecular film a is made to imide-ize at less than 50% of rate alpha of imide-izing (0% < alpha< 50%), and let it be the vertical orientation film 8, after carrying out the laminating of the monomolecular film a of the above-mentioned polyamic acid derivative compound to a necessary layer on a substrate 1.

[0025] Imide-ization of the cascade screen of the above-mentioned monomolecular film a is performed by using together both the chemical treatment by solutions, such as heat treatment or an acid anhydride, or said heat treatment and chemical treatment. Moreover, the rate alpha of imide-izing is controlled by heat treatment temperature or concentration of said chemical treatment solution (solutions, such as an acid anhydride).

[0026] The vertical orientation film 8 which makes-izing [the cascade screen of the monomolecular film a of the above-mentioned polyamic acid derivative compound] come [imide] is polyimide system film, and this polyimide film has structure like the next [-izing 6].

[0027]

[Formula 6]



[0028] The orientation film 8 and 9 which consists of polyimide film formed in both the substrates 1 and 2 as mentioned above has the stacking tendency to which orientation of the liquid crystal molecule A is carried out almost vertically with few pre tilt angles to the normal of an orientation film surface, and the stacking tendency is uniform over the orientation film whole region. The orientation film 8 and 9 which consists of the above-mentioned polyimide film has such a stacking tendency, because the rate alpha of imide-izing is made into less than (0% < alpha< 50%) 50%.

[0029] That is, since itself has a vertical stacking tendency, even if the monomolecular film a of the above-mentioned polyamic acid derivative compound imide-izes the cascade screen of this monomolecular film a and does not use it as the polyimide film, it can be used as the vertical orientation film. However, the display action which the liquid crystal molecule when impressing electric field to a liquid crystal layer fell, and this vertical orientation film of a direction that is not imide-ized was not fixed, therefore was stabilized since it carried out orientation of the liquid crystal molecule in the condition of becoming vertical nearly thoroughly to an orientation film surface, over the orientation film whole region, although that stacking tendency is uniform is no longer obtained.

[0030] Moreover, the polyimide film which imide-ized the cascade screen of the above-mentioned monomolecular film a at 50% or more of rate of imide-izing makes whenever [tilt-angle / of the liquid crystal molecule to the normal of the film surface] larger than 45 degrees, and comes to carry out level orientation of the liquid crystal molecule.

[0031] On the other hand, the stacking tendency of the above-mentioned orientation film 8 and 9 with which the rate of imide-izing consists of less than 50% of polyimide film is uniform over the orientation film whole region, and, moreover, it has the stacking tendency to which orientation of the liquid crystal molecule A is carried out almost vertically with few pre tilt angles to the normal of an orientation film surface.

[0032] For this reason, since according to the liquid crystal device of the above-mentioned example orientation of the liquid crystal molecule A is carried out uniformly, a uniform optical property can be obtained and the liquid crystal molecule A carries out orientation uniformly with the above-mentioned pre tilt angle, the liquid crystal molecule A when impressing electric field can fall, a direction can be fixed, and the stable display action can be made to perform.

[0033]

[Effect of the Invention] Since rate of imide-izing alpha% made the film which carried out the laminating of the monomolecular film of the reaction compound of polyamic acid and long-chain alkylamine for the vertical orientation film formed in both the substrate have imide-ized in 0< alpha<50 according to the liquid crystal device of this invention, Vertical orientation of the liquid crystal molecule can be uniformly carried out with a moderate inclination to the normal of a substrate side, consequently an optical property is made into homogeneity, the liquid crystal molecule when moreover impressing electric field can fall, and the display action which fixed the direction and was stabilized can be made to perform.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The sectional view of a liquid crystal device showing one example of this invention.
[Drawing 2] Drawing showing the covering approach of a monomolecular film.
[Description of Notations]
1 2 — Substrate
4 5 — Electrode
6 7 — Insulator layer
8 Nine — Vertical orientation film (less than 50% imide-ized film)
A — Liquid crystal molecule

[Translation done.]

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C09K 19/02		7457-4H		

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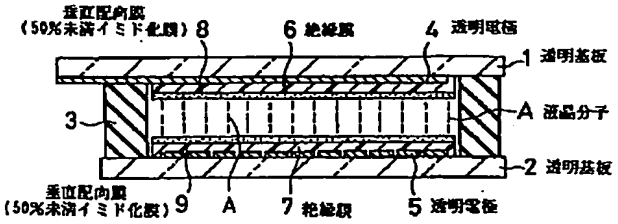
(54)【発明の名称】液晶素子

(57)【要約】
【目的】液晶分子を一様に略垂直に配向させて光学特性を均一にし、しかも電界を印加したときの液晶分子の倒れ方向を一定にして安定した表示動作を行なわせる。
【構成】基板１，２上に形成する垂直配向膜８，９を、ポリアミック酸と長鎖アルキルアミンとの反応化合物の単分子膜を積層した膜をイミド化率α％が０＜α＜５０の範囲でイミド化させたポリイミド系膜とした。



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【特許請求の範囲】

【請求項１】液晶層をはさんで対向する一対の透明基板の互いに対向する面に、透明電極と、液晶分子を基板面の法線に対して所定の傾きをもって配向させるための垂直配向膜とを形成してなり、かつ前記垂直配向膜は、ポリアミック酸と長鎖アルキルアミンとの反応化合物の単分子膜を積層し、イミド化率α％が０＜α＜５０の範囲でイミド化された膜からなることを特徴とする液晶素子。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は液晶分子を垂直配向させた液晶素子に関するものである。

【０００２】

【従来の技術】液晶分子を垂直配向させた液晶素子には、動的散乱（ＤＳ）モード、電界制御型複屈折（ＥＣＢ）モードのうちの垂直配向型モード、相転移モード等のものがある。

【０００３】これらの液晶素子は、液晶層をはさんで対向する一対の透明基板の互いに対向する面に、透明電極と、液晶分子を基板面に対して垂直に配向させるための垂直配向膜とを形成したもので、前記垂直配向膜は、従来、基板面に長鎖のアルキル基を有する界面活性剤溶液を塗布して乾燥させることにより形成されている。

【０００４】

【発明が解決しようとする課題】しかしながら、上記のように界面活性剤溶液を塗布して垂直配向膜を形成している従来の液晶素子は、その垂直配向膜の配向性にばらつきがあるため、液晶分子を一様に垂直配向させることができず、そのために均一な光学特性が得られないし、また液晶分子が配向膜面に対してほぼ完全に垂直な状態で配向するため、液晶層に電界を印加したときの液晶分子の倒れ方向が一定せず、したがって安定した表示動作が得られないという問題をもっていた。

【０００５】本発明の目的は、液晶分子を一様に略垂直に配向させて光学特性を均一にし、しかも電界を印加したときの液晶分子の倒れ方向を一定にして安定した表示動作を行なわせることができる液晶素子を提供することにある。

【０００６】

【課題を解決するための手段】本発明の液晶素子は、液晶層をはさんで対向する一対の透明基板の互いに対向する面に、透明電極と、液晶分子を基板面の法線に対して所定の傾きをもって配向させるための垂直配向膜とを形成してなり、かつ前記垂直配向膜は、ポリアミック酸と長鎖アルキルアミンとの反応化合物の単分子膜を積層し、イミド化率α％が０＜α＜５０の範囲でイミド化された膜からなることを特徴とするものである。

【０００７】

【作用】上記ポリアミック酸と長鎖アルキルアミンとの反応化合物の単分子膜を積層した膜をイミド化率α％が０＜α＜５０の範囲でイミド化させた配向膜は、液晶分子を配向膜面の法線に対して僅かなプレチルト角をもってほぼ垂直に配向させる配向性をもっており、またその配向性は配向膜全域にわたって均一である。このため、本発明の液晶素子によれば、液晶分子を一様に配向させて均一な光学特性を得ることができるし、また液晶分子が上記プレチルト角をもって一様に配向するため、電界を印加したときの液晶分子の倒れ方向を一定にして安定した表示動作を行なわせることができる。

【０００８】

【実施例】以下、本発明の一実施例を図１および図２を参照して説明する。

【０００９】図１は液晶素子の断面図である。この液晶素子は、ガラス等からなる一対の透明基板１，２を枠状のシール材３を介して接合し、この両基板１，２間のシール材３で囲まれた領域に液晶を封入したもので、上記両基板１，２の互いに対向する面にはそれぞれ、透明電極４，５が形成されている。また、この両基板１，２の電極形成面は、酸化硅素（Ｓｉ Ｏ$_2$）等からなる透明な絶縁膜６，７で覆われており、この絶縁膜６，７の上に、液晶分子Ａを基板１，２面に対してほぼ垂直に配向させるための垂直配向膜８，９が形成されている。

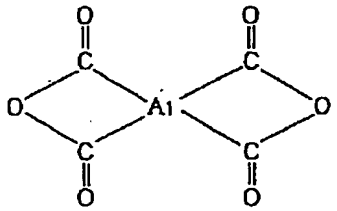
【００１０】上記垂直配向膜８，９は、いずれも、ポリアミック酸と長鎖アルキルアミンとの反応化合物の単分子膜を複数層に積層した膜をイミド化率α％が０＜α＜５０の範囲でイミド化させたものである。

【００１１】この垂直配向膜８，９は、次のような方法で形成する。なお、ここでは、一方の基板１に設ける垂直配向膜８の形成について説明するが、他方の基板２に設ける垂直配向膜９も同様にして形成する。

【００１２】上記ポリアミック酸は、下記の［化３］の構造式で表わされ、このポリアミック酸は、［化１］の構造式で表わされるテトラカルボン酸二無水物と、［化２］の構造式で表わされるジアミンとを合成して得られる。

【００１３】

【化１】



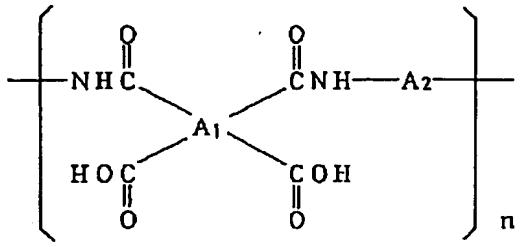
【００１４】

【化２】

$$H_2N-A_2-NH_2$$

【００１５】

【化３】

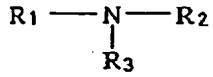


nは１以上の整数

【００１６】また、上記長鎖アルキルアミンは、親水性をもつポリアミック酸に疎水性を付与するためのものであり、この長鎖アルキルアミンは次の［化４］の構造式で表わされる。

【００１７】

【化４】



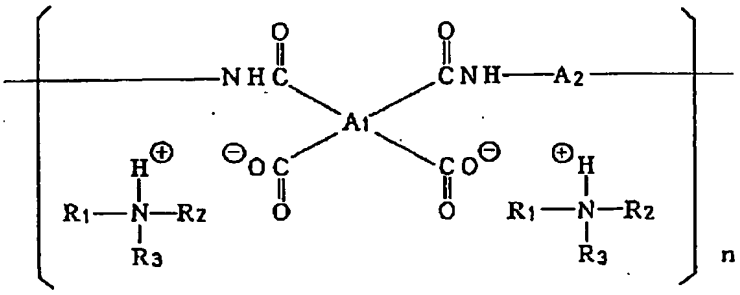
R1，R2は低級アルキル基または水素原子

R3は長鎖のアルキル基

【００１８】上記ポリアミック酸を溶媒に溶かした溶液と、上記長鎖アルキルアミンを同じ溶媒に溶かした溶液とを１：１の割合で混合し、上記ポリアミック酸と長鎖アルキルアミンとをイオン結合反応させて、下記の［化５］の構造式で表わされるポリアミック酸誘導体化合物（ポリアミック酸塩）の溶液を作成する。なお、上記ポリアミック酸および長鎖アルキルアミンの溶媒としては、ＮＭＰ（Ｎ－メチルー２－ピロリジノン）とベンゼンを１：１の割合で混合した混合溶媒を用いる。また、長鎖アルキルアミン溶液の濃度は、ポリアミック酸溶液の濃度と同じか、あるいはそれより濃い濃度とする。

【００１９】

【化５】



【００２０】そして、水平配向膜８は、透明電極４を形成しその上に絶縁膜６を形成した基板１上に、ＬＢ法によって上記ポリアミック酸誘導体化合物の単分子膜を所要層に積層して被着させ、この単分子膜の積層膜を、熱処理によりイミド化して形成する。図２は、基板１上にポリアミック酸誘導体化合物の単分子膜をＬＢ法によって被着させる方法を示している。この単分子膜の被着は次のようにして行なう。まず、上記基板１の単分子膜被着面（絶縁膜６面）に親水性処理を施し、この基板１を水槽１０内の水中に垂直に浸漬させる。

【００２１】次に、水槽１０内の水面を静水面とした後、水面高さに設けたバー状の移動バリア１１と基板１との間の水面上に上記ポリアミック酸誘導体化合物の溶液を滴下して、その単分子膜ａを水面上に展開させる。

【００２２】次に、移動バリア１１を基板方向に移動させて水面上の単分子を密集させ、単分子膜ａの表面圧を一定圧（２５dyn/cm）に調整しつつ、移動バリア１１を基板方向に一定速度（２mm/min）で移動させて単分子膜ａを基板方向に押しながら、これに同調させて基板１を引上げて、水面上の単分子膜ａを基板１上に被着させる。

【００２３】このとき、水面上の単分子は、親水性をもつ部分が親水性処理を施してある基板１に付着して引上げられるため、単分子膜ａは、分子がほぼ一方向に並んだ状態で基板１上に被着する。以下は、上記単分子膜ａの被着工程を繰返して、基板１上に上記単分子膜ａを所要層に積層する。

【００２４】このようにして基板１上に上記ポリアミック酸誘導体化合物の単分子膜ａを所要層に積層した後は、この単分子膜ａの積層膜を、５０％未満のイミド化率α（０％＜α＜５０％）でイミド化させて垂直配向膜８とする。

【００２５】上記単分子膜ａの積層膜のイミド化は、熱処理、または酸無水物等の溶液による化学処理、あるいは前記熱処理と化学処理との両方を併用して行なう。また、イミド化率αは、熱処理温度または前記化学処理溶液（酸無水物等の溶液）の濃度等により制御する。

【００２６】上記ポリアミック酸誘導体化合物の単分子

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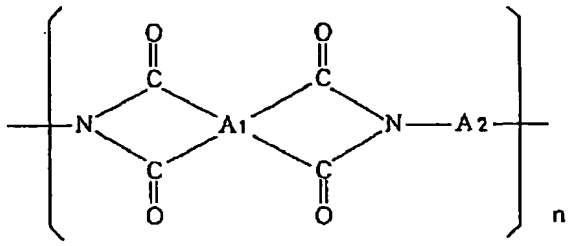
膜ａの積層膜をイミド化させてなる垂直配向膜８はポリイミド系膜であり、このポリイミド膜は、次の［化６］のような構造をもっている。

【００２７】

【化６】



【００２８】上記のようにして両基板１，２に形成したポリイミド膜からなる配向膜８，９は、液晶分子Ａを配向膜面の法線に対して僅かなプレチルト角をもってほぼ垂直に配向させる配向性をもっており、またその配向性は配向膜全域にわたって均一である。上記ポリイミド膜からなる配向膜８，９がこのような配向性をもつのは、そのイミド化率αを５０％未満（０％＜α＜５０％）としているためである。

【００２９】すなわち、上記ポリアミック酸誘導体化合物の単分子膜ａは、それ自体が垂直配向性をもっているため、この単分子膜ａの積層膜をイミド化してポリイミド膜としなくても、垂直配向膜とすることができる。しかし、このイミド化しない垂直配向膜は、その配向性は配向膜全域にわたって均一であるが、液晶分子を配向膜面に対してほぼ完全に垂直になる状態で配向させるため、液晶層に電界を印加したときの液晶分子の倒れ方向が一定せず、したがって安定した表示動作が得られなくなってしまう。

【００３０】また、上記単分子膜ａの積層膜を５０％以上のイミド化率でイミド化したポリイミド膜は、その膜

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面の法線に対する液晶分子の傾斜角度を４５°より大きくし、液晶分子を水平配向させるようになる。

【００３１】これに対して、イミド化率が５０％未満のポリイミド膜からなる上記配向膜８，９は、その配向性が配向膜全域にわたって均一であり、しかも、液晶分子Ａを配向膜面の法線に対して僅かなプレチルト角をもってほぼ垂直に配向させる配向性をもっている。

【００３２】このため、上記実施例の液晶素子によれば、液晶分子Ａを一様に配向させて均一な光学特性を得ることができるし、また液晶分子Ａが上記プレチルト角をもって一様に配向するため、電界を印加したときの液晶分子Ａの倒れ方向を一定にして、安定した表示動作を行なわせることができる。

【００３３】

【発明の効果】本発明の液晶素子によれば、その両基板に形成する垂直配向膜を、ポリアミック酸と長鎖アルキルアミンとの反応化合物の単分子膜を積層した膜をイミド化率α％が０＜α＜５０の範囲でイミド化させたものとしているため、液晶分子を一様に基板面の法線に対し適度な傾きをもって垂直配向させることができ、その結果、光学特性を均一にし、しかも電界を印加したときの液晶分子の倒れ方向を一定にして安定した表示動作を行なわせることができる。

【図面の簡単な説明】

【図１】本発明の一実施例を示す液晶素子の断面図。

【図２】単分子膜の被着方法を示す図。

【符号の説明】

１，２…基板

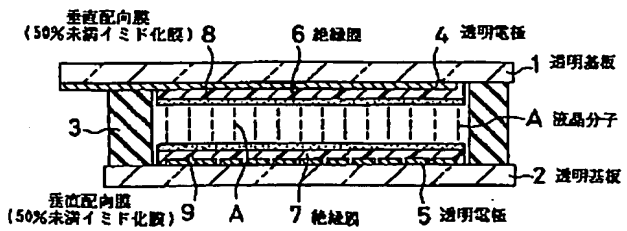
４，５…電極

６，７…絶縁膜

８，９…垂直配向膜（５０％未満イミド化膜）

Ａ…液晶分子

【図１】



【図２】